LIQUEFACTION-SUSCEPTIBILITY AND SEISMIC SOIL-TYPE MAPS OF ANCHORAGE, ALASKA

Award 01HQGR0006

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INVESTIGATIONS

An existing published map (Harding-Lawson Associates, 1979) portrays ground-failure susceptibility in the Anchorage area and has been in use by the Municipality of Anchorage for several years as the basis of an earthquake-related zoning ordinance. Depiction of hazards zones on the map was based on earthquake-induced ground displacements that were initiated largely by sensitive-clay failures during the 1964 great Alaska earthquake and on empirical data regarding seismic behavior of geologic units portrayed on a generalized geologic map of Anchorage (Schmoll and Dobrovolny, 1972). Subsurface data were not used in preparation of the Harding-Lawson map, consequently liquefaction susceptibility of sand and silt was not evaluated. With the geotechnical borehole database recently compiled by the Alaska Division of Geological & Geophysical Surveys (ADGGS), we have acquired the kinds of data (soil classification, standard penetration tests, sample analytical data, groundwater level) necessary to evaluate liquefaction susceptibility of deposits in the Anchorage area. We have completed the initial data compilation and will use the data in conjunction with revised simplified procedures (Seed and Idriss, 1971, 1982; Idriss, 1997; Youd, 1997) to produce a liquefaction-susceptibility map of Anchorage at 1:25,000 scale. We do not plan to re-map susceptibility to sensitive-clay failure at this time because there is insufficient city-wide borehole data on clay properties to improve significantly on the Harding-Lawson map.

Geotechnical engineers and building officials in the Anchorage area have expressed the need for a map showing seismic soil types (site classes) that can be used in conjunction with the Uniform Building Code to estimate the seismic design requirements of most small structures. While site-specific analysis is necessary for large or critical facilities, the requirements of the Anchorage code can be satisfied with reliable map data for most other structures. Because the soil-profile classifications of the Uniform Building Code have been replaced with the NEHRP-recommended site-classes (Building Seismic Safety Council, 1995), we are preparing a 1:25,000-scale map of the NEHRP site classes for Anchorage. We are collaborating with investigators at the University of Alaska to classify seismic site classes on the basis of surface-measured shear-wave velocity profiles in Anchorage (Biswas and others, 1993; Biswas and Dravinski, 1994; Nath and others, 1997) and a small number of available downhole shear-wave velocity tests. We are also using the borehole data we have compiled (standard penetration data, soil types, layer

thicknesses, and sample analytical data) to determine seismic site classes in areas where velocity data are not available. We are analyzing these data in conjunction with engineering-geology maps and cross sections (Combellick, 1999; Updike and Ulery, 1986; Updike, 1986) to create the final seismic site-class map.

RESULTS

We have completed a draft 1:25,000-scale map of seismic site classification and surficial geology (fig. 1), which we have distributed to about two dozen users in the Anchorage geotechnical community for comments. We have discovered that, because in many areas the

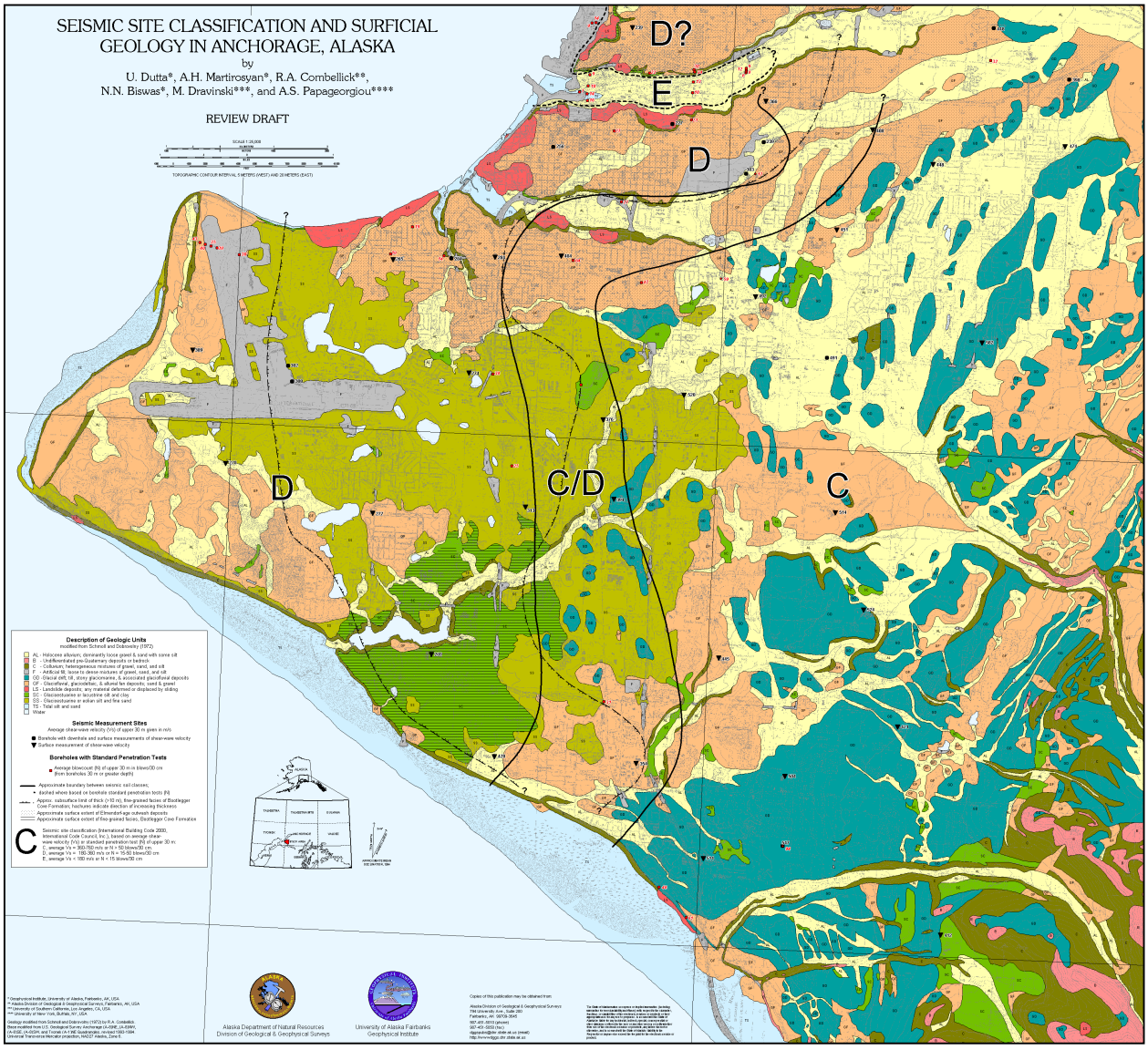

Figure 1 - Draft map of seismic site classification and surficial geology in Anchorage, Alaska.

shallow surficial deposits depicted on the geologic map are underlain by deposits of distinctly different seismic properties, the distribution of seismic site-classes based on average seismic velocity and penetration resistance in the upper 30 m bears little relation to the contacts between

surficial-geologic map units. Additionally, because the transition between seismic site classes C and D is diffuse, we depict this transition area as a band on the map to which we assign site class C/D. We are presently incorporating user comments we have received into final revisions to the map before submitting it for publication. The publication process will include a technical peer review.

Now that compilation of the borehole database is complete, we are evaluating and compiling appropriate data from it for the purpose of performing liquefaction-susceptibility analyses using the simplified Seed-Idriss methods. The results of these analyses will be used to generate a liquefaction-susceptibility map of the Anchorage area.

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NONTECHNICAL SUMMARY

The purpose of this project is to produce two maps of Anchorage to help mitigate earthquake hazards. One is a seismic site-class map, a draft of which we have completed and distributed to geotechnical users for comments. The map is designed to be used with the International Building Code to help estimate design requirements for resisting earthquake-shaking damage. The second product is a map showing areas susceptible to liquefaction during strong earthquakes. This map, currently under development, will help identify areas that should be avoided or where special designs must be used to prevent damage from earthquake-induced ground failures.